

## INTERNATIONAL COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

BOWDERY, A.O.  
Qinetiq Limited  
IP Formalities  
A4 Bldg., Cody Technology Park  
Ively Road, Farnborough  
Hampshire GU14 0LX  
ROYAUME-UNI

Date of mailing (day/month/year)

12 November 2001 (12.11.01)

Applicant's or agent's file reference

JL2428

## IMPORTANT NOTIFICATION

International application No.

PCT/GB00/00951

International filing date (day/month/year)

15 March 2000 (15.03.00)

1. The following indications appeared on record concerning:

☒

the applicant

☐

the inventor

☐

the agent

☐

the common representative

Name and Address

THE SECRETARY OF STATE FOR DEFENCE  
Defence Evaluation and Research  
Agency  
Farnborough  
Hampshire GU14 0LX  
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒

the person

☐

the name

☐

the address

☐

the nationality

☐

the residence

Name and Address

QINETIQ LIMITED  
85 Buckingham Gate  
London SW1 6TD  
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒

the receiving Office

☐

the designated Offices concerned

☐

the International Searching Authority

☒

the elected Offices concerned

☒

the International Preliminary Examining Authority

☐

other:

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Authorized officer

R. Chrem

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

## INTERNET COOPERATION TREA

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

BOWDERY, A.O.  
Qinetiq Limited  
IP Formalities  
A4 Bldg., Cody Technology Park  
Ively Road, Farnborough  
Hampshire GU14 0LX  
ROYAUME-UNI

Date of mailing (day/month/year) 12 November 2001 (12.11.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference JL2428	
International application No. PCT/GB00/00951	International filing date (day/month/year) 15 March 2000 (15.03.00)

## 1. The following indications appeared on record concerning:

☐ the applicant    ☐ the inventor    ☒ the agent    ☐ the common representative

Name and Address BARKER BRETTELL 138 Hagley Road Edgbaston Birmingham B16 9PW United Kingdom	State of Nationality	State of Residence
	Telephone No. 0121-456-1364	
	Facsimile No. 0121-456-1368	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person    ☐ the name    ☐ the address    ☐ the nationality    ☐ the residence

Name and Address BOWDERY, A.O. Qinetiq Limited IP Formalities A4 Bldg., Cody Technology Park Ively Road, Farnborough Hampshire GU14 0LX United Kingdom	State of Nationality	State of Residence
	Telephone No. 44 01252 392710	
	Facsimile No. 44 01252 393920	
	Teleprinter No.	

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer R. Chrem Telephone No.: (41-22) 338.83.38
---	--

## PATENT COOPERATION TREATY

Best Available Copy

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

<b>Date of mailing (day/month/year)</b> 08 December 2000 (08.12.00)	
<b>International application No.</b> PCT/GB00/00951	<b>Applicant's or agent's file reference</b> JL2428
<b>International filing date (day/month/year)</b> 15 March 2000 (15.03.00)	<b>Priority date (day/month/year)</b> 16 March 1999 (16.03.99)
<b>Applicant</b> WALLIS, David, John et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 10 October 2000 (10.10.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<b>The International Bureau of WIPO</b> 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	<b>Authorized officer</b> Olivia TEFY Telephone No.: (41-22) 338.83.38
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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>JL2428</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 00/ 00951</b>	International filing date (day/month/year) <b>15/03/2000</b>	(Earliest) Priority Date (day/month/year) <b>16/03/1999</b>
Applicant <b>THE SECRETARY OF STATE FOR DEFENCE et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

1



None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 00/00951

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7<sup>-</sup> G01N23/20 G01N23/207

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DD 270 770 A (FREIBERG BERGAKADEMIE) 9 August 1989 (1989-08-09)	1-4, 6-8, 11-15, 18, 23, 24, 29, 30, 32, 33
A	the whole document	6, 28
Y	---	37
Y	US 5 414 747 A (RUUD CLAYTON O ET AL) 9 May 1995 (1995-05-09) cited in the application abstract ---	37
	--- -/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

19 October 2000

Date of mailing of the international search report

25/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Hulne, S

## INTERNATIONAL SEARCH REPORT

International Application No

PC 00/00951

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MAZUELAS A ET AL: "Strain compensation in highly carbon doped GaAs/AlAs distributed Bragg reflectors" JOURNAL OF CRYSTAL GROWTH, NL, NORTH-HOLLAND PUBLISHING CO. AMSTERDAM, vol. 175-176, no. 3001, 1 May 1997 (1997-05-01), pages 383-386, XP004091323 ISSN: 0022-0248 abstract ----	1,28
X	VELLING P ET AL: "InGaP/GaAs hole barrier asymmetry determined by (002) X-ray reflections and p-type DB-RTD hole transport" JOURNAL OF CRYSTAL GROWTH, NL, NORTH-HOLLAND PUBLISHING CO. AMSTERDAM, vol. 195, no. 1-4, 15 December 1998 (1998-12-15), pages 117-123, XP004154248 ISSN: 0022-0248 page 118 -page 119 -----	1,2,15, 16,18

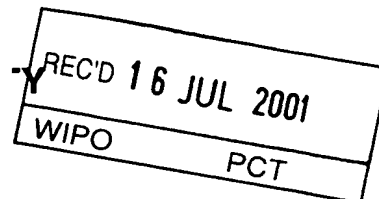
# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC 00/00951

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DD 270770	A	09-08-1989	NONE
US 5414747	A	09-05-1995	NONE



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference JL2428		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/00951	International filing date (day/month/year) 15/03/2000	Priority date (day/month/year) 16/03/1999
International Patent Classification (IPC) or national classification and IPC G01N23/20		
Applicant THE SECRETARY OF STATE FOR DEFENCE et al.		



1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  

7

 These annexes consist of a total of 7 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  10/10/2000	Date of completion of this report  12.07.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Rouault, P  Telephone No. +49 89 2399 2776  



# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00951

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-29 as originally filed

**Claims, No.:**

12-32 as received on 27/12/2000 with letter of 20/12/2000

1-11,33,34 with telefax of 18/05/2001

**Drawings, sheets:**

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00951

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

**see separate sheet**

6. Additional observations, if necessary:

### III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 24.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 24 are so unclear that no meaningful opinion could be formed (*specify*):  
**see separate sheet**

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

### IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00951

- ☐ restricted the claims.
  - ☐ paid additional fees.
  - ☐ paid additional fees under protest.
  - ☐ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
  - ☒ not complied with for the following reasons:  
**see separate sheet**
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☒ all parts.
  - ☐ the parts relating to claims Nos. .

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes:	Claims	4, 5, 7, 8, 14, 16, 18, 20-23, 26, 32-34
	No:	Claims	1-3, 6, 9-13, 15, 17, 19, 25, 27-31
Inventive step (IS)	Yes:	Claims	
	No:	Claims	4, 5, 7, 8, 14, 16, 18, 20-23, 26, 32-34
Industrial applicability (IA)	Yes:	Claims	1-34
	No:	Claims	

### 2. Citations and explanations **see separate sheet**

Concerning item I:

For the below-mentioned reason, the amendments made in Claim 1 are considered to go beyond the disclosure in the international application as filed.

Concerning the integration of a portion of the diffracted curve, the original description only mentions that the "peak intensity for the layers was integrated over a window **centred on the highest point of the peak**" (see page 24, lines 17, 18 of the original disclosure). The wording used in new Claim 1 is, however, much more broader, since it suggests that any portion of the diffraction peak could be integrated in order to determine the relative amounts of different chemical elements. It results for example from that wording that the selected portion is not necessarily centred on the highest point of the peak, but that this portion could be located completely either right or left of the peak, which alternative is not directly and unambiguously derivable from the original disclosure.

Accordingly, the amendments made in Claim 1 have not been taken into consideration for assessing the novelty and inventive step of the subject-matter of that claim, pursuant to Rule 70.2(c).

Concerning item III:

Independent Claim 24 is totally unclear, contrary to the requirements of Article 6 PCT. It is not understood how the steps defined in that claim, and in particular which parameter, could allow for the analysis of the composition of a material.

Concerning item IV:

Since the subject-matter of independent Claim 1 is not new (see V.2 below), that claim and independent Claim 24 are not so linked as to form a single general inventive concept (Rule 13.1 PCT).

Concerning item V:

1. Reference is made to the following document:

D1: VELLING P ET AL: 'InGaP/GaAs hole barrier asymmetry determined by (002) X-ray reflections and p-type DB-RTD hole transport' JOURNAL OF CRYSTAL GROWTH, NL, NORTH-HOLLAND PUBLISHING CO. AMSTERDAM, vol. 195, no. 1-4, 15 December 1998 (1998-12-15), pages 117-123, XP004154248 ISSN: 0022-0248

2. Novelty of the subject-matter of Claim 1:

Document D1 discloses a method of determining the relative amounts of different chemical elements like In and Ga in the chemical composition of a crystalline semiconductor material.

This method comprises the following steps of:

- diffracting a beam of radiation off the crystalline material (see page 120, right column, last paragraph, second sentence);
- measuring the angle of at least one diffraction peak and the intensity of diffracted radiation at that diffraction angle (see Fig. 2b), and
- using a processor to determine the relative amounts of the said element in the chemical composition of the crystalline material by using values derived from the radiation scattering powers of said chemical elements and the position and intensity of said at least one diffraction peak (see paragraph "3. X-ray diffraction analysis" and "4. Results and discussion": The structure factor that is used for simulating in D1 theoretical diffraction curves corresponding to different chemical compositions of the material under examination is known by the skilled person to be dependent upon the scattering powers of the chemical elements in that material; these simulated curves are then compared with the measured curve, see especially Fig. 2, in order to find out the curve which best fits to the measured curve; the chemical composition assumed for simulating that best curve is therefore considered to represent the actual chemical composition of said material).

Therefore, document D1 reveals a method identical to that defined in new Claim 1 of the application. Accordingly, the subject-matter of that claim lacks novelty in view of D1 and the present application does not meet the requirements of Art. 33 (2) PCT.

It is to be noted that if the wording "window centred on the highest point of the peak" had been used in Claim 1 instead of the wording "a portion", the subject-matter of Claim 1 would have then appeared to be novel and non-obvious with respect to the available prior art.

3. Novelty of the subject-matter of independent Claims 25, 28-31:

Since the apparatus disclosed in D1 implicitly allows to carry out all the steps of the method described in D1, the objection raised above against Claim 1 also applies to Claim 25 whose subject-matter, hence, is not novel having regard to the teachings of D1. It follows therefrom that the subject-matter of independent Claim 29 lacks novelty with respect to D1, because the program allowing to run the apparatus of D1 is at least available in a memory (ROM or RAM) or on a hard disk, both elements being considered as being data carrier.

Furthermore, the subject-matter of independent Claims 28, 30 and 31 is not novel either, because document D1 reveals an apparatus for checking and/or analysing a wafer of a semiconductor material (see especially page 118, right column, part "2. Experimental procedures", third sentence).

4. Dependent Claims 2-23 and 26, 27, 32, 33, independent Claim 34:

The subject-matter of Claims 2, 3, 6, 9-13, 15, 17, 19 and 27 is considered to be disclosed either implicitly or explicitly in D1 (see the above-mentioned passages of that document).

The subject-matter of Claims 4, 5, 7, 8, 14, 16, 18, 20-23, 26, 32 and 33 does not appear to involve an inventive step (Art. 33 (3) PCT, having regard to the teachings of D1 (see the above-mentioned passages of that document) and to the common knowledge of the skilled person in the technical field of X-ray analysis of semiconductor materials.

The subject-matter of independent Claim 34 is similar to that of dependent Claim 14, which is not considered to involve an inventive step, because the skilled person knowing D1 would certainly not restrict the teachings of that document to

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB00/00951

tertiary samples. It would namely be obvious to him that the method described in D1 could be applied to a crystalline quaternary semiconductor material as well.

## CLAIMS

1. A method of analysing the chemical composition of a semiconductor material comprising irradiating the semiconductor material with energy from an energy source which energy is diffracted from the semiconductor material, detecting one or more portions of the diffracted energy, and analysing the or each detected portion to obtain a parameter indicative of the intensity of the or each portion, and using knowledge of the position and/or intensity of a portion of diffracted energy to determine the chemical composition of the semiconductor.
2. A method of determining the relative amounts of different chemical elements E1 to En in the chemical composition of a crystalline semiconductor material, the method comprising diffracting a beam of radiation off the crystalline material and measuring the angle of at least one defraction peak and the intensity of diffracted radiation at that diffraction angle, and using a processor to determine the relative amounts of the elements E1 to En in the chemical composition of the crystalline material by using values derived from the radiation scattering powers of the elements E1 to En and the position and intensity of said at least one diffraction peak.
3. A method according to claim 1 or claim 2 in which the or each or some of the diffraction peaks, or the or each or some of the portions of the diffracted energy, is at a quasi-forbidden angle of diffraction from the semiconductor material.
4. A method according to claim 2 in which the or each or some of the quasi-forbidden diffraction is at a (002) reflection.



5. A method according to claim 2 or claim 3 in which the or each or some of the quasi-forbidden diffractions is at a (006) reflection.

6. A method according to claim 1 or claim 2 in which the or each or  
5 some of the diffraction peaks or the or each or some of the portions of the diffracted energy is resultant from a (004) reflection.

7. A method according to any preceding claim which comprises using a knowledge of the structure of the material and the possible elements  
10 present in the material to determine the chemical composition of the material.

8. A method according to claim 2 or any claim dependent directly or indirectly from claim 2 in which the crystalline semiconductor material is  
15 assumed to be comprised of only a finite number of known predetermined chemical elements and the processor has operational in its processing of the measured input data and stored element scattering power values only the scattering powers for the known predetermined assumed finite number of elements that are assumed to be present.

20

9. A method according to claim 8 in which the material is assumed to be comprised of four or less chemical elements.

10. A method according to any preceding claim which comprises  
25 determining the composition of a layer of a material and makes use of a knowledge of the thickness of the layer, or an assumption of the thickness of the layer being analysed.

11. A method according to any of claims 1 to 10 which comprises determining the composition of a single layer of a material on a substrate of the material.

5 12. A method according to any preceding claim which comprises measuring the position of at least two diffraction peaks or at least two portions of the diffracted energy and using a knowledge of their position to determine the relative amount of chemical elements in the chemical composition of the semiconductor material.

10

13. A method according to any preceding claim which comprises measuring the intensity of diffracted beams at at least two positions or measuring the intensity of at least two portions of the diffracted energy and using this knowledge to determine the chemical composition of the  
15 semiconductor material.

14. A method according to any preceding claim which comprises measuring the intensity of two diffraction peaks or two portions of the diffracted energy.

20

15. A method according to any preceding claim in which the semiconductor material is a quaternary semiconductor material.

16. A method according to any one of claims 1 to 14 in which the  
25 semiconductor material is a ternary semiconductor material.

17. A method according to claim 15 which further comprises measuring or assuming a parameter indicative of the lattice parameter of the quaternary semiconductor material, and using this parameter and the  
30 intensity of a diffraction peak or the parameter indicative of the intensity

to provide, in a single diffraction measurement, an estimate of the composition of the material.

18. A method according to any preceding claim in which the  
5 semiconductor material is a III-V semiconductor material.

19. A method according to any preceding claim in which the  
composition of an at least partially strained semiconductor material is  
analysed.

10

20. A method according to any preceding claim in which the  
semiconductor material is a single crystal material.

21. A method according to claim 1 or any claim dependent directly or  
15 indirectly from claim 1 in which the parameter is normalised.

22. A method according to any preceding claim in which the percent of  
each chemical element of the chemical composition of the semiconductor  
material is analysed with an error of 0.1% or below.

20

23. A method according to claim 1 or any claim dependent directly or  
indirectly upon claim 1 in which detection of the diffracted energy takes  
place at one or more detection angles, or at a range of angles around one  
or more detection angles.

25

24. A method according to claim 1 or any claim dependent directly or  
indirectly upon claim 1 in which the diffracted energy is detected at one  
or more angles by movement of one or more detectors, or by movement  
or rocking of the semiconductor material.

30

25. A method according to any preceding claim which further comprises measuring a parameter indicative of the lattice parameter of the semiconductor material.

5 26. A method according to claim 25 which is used to analyse the composition of a buried, non-surface, layer in the semiconductor material.

27. A method according to any preceding claim which further comprises comparing the detected composition of the semiconductor  
10 material to a reference composition to determine if the detected composition is equal to that composition or falls within a predetermined range around the reference composition, and producing a first output if the measured composition falls within the range and a second output if the measured composition falls outside the range.

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28. A method of analysing the composition of an at least partially strained material comprising irradiating the material with energy from an energy source which energy is diffracted from the material, detecting one or more portions of the diffracted energy, and analysing the or each  
20 detected portion to obtain a parameter indicative of the position and/or intensity of the or each portion.

29. A method of analysing the composition of a material comprising irradiating the material with energy from an energy source which energy  
25 is diffracted from the material, detecting one or more portions of the diffracted energy comprising quasi-forbidden reflections, and analysing the or each detected portion to obtain a parameter indicative of the position and/or intensity of the or each portion.

30. Chemical composition analysis apparatus comprising a sample holder, a beam source, a detector or detectors, a controller, and a processor, the controller being adapted to control the beam source and detector in use so as to direct a beam of energy onto a sample held in the sample holder and detect diffracted energy at diffraction angles, the detector(s) being coupled to the processor to provide the processor in use with signals representative of the position of a diffraction peak and the intensity of the diffraction peak, and the processor being arranged such that in use it uses the detected signals, in combination with an assumption of what predetermined elements are present in the sample and the scattering power of atoms of the elements that are assumed to be present, or a factor dependent upon the scattering power of the predetermined elements, to evaluate the relative amounts of the predetermined chemical elements in the chemical composition of the sample.

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31. Apparatus according to claim 30 having an element selection inputter adapted to enable a user to identify to the processor which chemical elements are to be assumed to be present in the sample to be analysed, and therefore which chemical element scattering powers, or factor dependent upon the scattering powers, are to be used by the processor in determining the relative amounts of the chemical elements in the sample, the processor being adapted in use to operate with its processor on the measured input variables from the detector(s) and a subset of element scattering powers, or derived values, selected from a larger set of stored element scattering powers, or derived values, the subset being selectable by the operation of the element selection inputter.

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32. Apparatus according to claim 30 or claim 31 in which the sample holder, beam source and detector(s) are pre-set at predetermined positions relative to each other at a relationship where for a sample of a known kind

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the or at least one detector is disposed so as to detect at a quasi-forbidden diffraction angle.

33. Semiconductor wafer checking apparatus comprising apparatus  
5 according to any one of claims 30 to 32.

34. A data carrier carrying a programme which when running on  
detection apparatus is adapted to enable the apparatus to perform a method  
of any one of Claims 1 to 29, or which when loaded into a control  
10 computer of the detection apparatus is adapted to provide the apparatus of  
any one of Claims 30 to 33.

35. Apparatus for the analysis of the composition of a semiconductor  
material being arranged to operate in use in accordance with the method  
15 of any of claims 1 to 29.

36. A composition measurement system arranged to analyse the  
composition of a semiconductor material according to any of claims 1  
to 2, and to compare this to a reference or output the results of the  
20 analysis.

37. A method of manufacturing a semiconductor chip comprising  
manufacturing a semiconductor wafer, analysing the composition of the  
wafer according to any one of claims 1 to 29 to test if it passes or fails a  
25 composition analysis test, and performing fabrication operations on the  
wafer to produce the chip if the wafer has a composition within  
predetermined parameters, and rejecting the wafer for further processing  
or fabrication operations if it has a composition outside of the  
predetermined parameters, rejected wafers not being subject to at least  
30 one processing step that they would have received had they passed.

38. A method according to claim 37 in which wafers that pass the compositional analysis test and/or chips produced from such wafers are accompanied by data either confirming that they passed, or data giving  
5 details of their compositional analysis.

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